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Vehicle Number Plate Identification using Computer Vision

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Abstract: *Vehicle Number Plate Identification is a widely studied problem, with numerous successful solutions tailored to specific environments due to the variations in number plate features worldwide. Designing a universal solution is challenging since image analysis techniques employed in building these algorithms are not flawless. This research paper introduces an optimized algorithm, implemented in Python with the OpenCV library, specifically designed for vehicle number plates. The algorithm employs edge detection, Feature Detection techniques, and mathematical morphology to accurately locate the plate. Subsequently, the Tesseract OCR engine is utilized to identify the characters present on the detected plate.*

Keywords: Automatic Number Plate, Character Recognition, Character Segmentation, Grace Scale Conversion, OpenCV, Character Extraction, Character Localization, Image Processing

I. INTRODUCTION

The Automatic number plate identification in today's world plays a vital role in vehicle tracking and organization. Our proposed model of automation in the detection and recognizing vehicles through the use of number plate computerization is expected to create a new scope of evolution for large cities.

The system can be used for the parking system of motor vehicles, as well as to collect tolls. The detection of the number plates from different cities and multi-class vehicles is the first step of the proposed system.

The number plate detection has been performed with the computer vision approach, OCR (Optical Character Recognition) and You Only Look Once (YOLO) algorithm.

II. LITERATURE SURVEY

Literature Survey is an important phase in the system development life cycle as we collect and acquire the necessary information to handle or develop a project during this phase. A literature review is a description of the literature relevant to particular field or topic. It gives an overview of what has been said, who the key writers are, what are the prevailing theories and hypothesis and what methods and what methodologies are appropriate and useful.

In this project research is done prior to taking up the project and understanding the various methods that were used previously. A detailed analysis of the existing systems was performed. This study helped to identify the benefits and drawbacks of the existing systems.

Mr. R. Islam,Mr. N. Suleman In this paper they [4] proposed that Vehicle Number Plate Identification is a method that catches the vehicle image and confirmed their license number. ANPR can be used in the presentation of stolen vehicles. It can be used in various manners by using to identify its stolen vehicle on the highway.

Sarthak Babbar, Saommya Kesarwani, Navroz Dewan, Kartik Shangle and Sanjeev Patel [5] This paper presents about car plate recognition system. It describes, design algorithm and future of implementation. The system has three main steps to get the desired information. Those are plate localization, character segmentation and character recognition.

F. A. Aiyelabegan, C. C. Emmanuel, S. Thomas, F. A. Imam, H. Haruna Ginsau and F. Onah [7] The paper describes about Real-Time Vehicle Number Plate Recognition (ANPR) has been a recurrent subject of research study as a result of many real-world implementations.

Sulaiman, N., Jalani, S. N. H. M., Mustafa, M., and Hawari, K. [2] Automatic number plate recognition system (or ANPR) is a system that uses optical character recognition to read characters from solid images automatically.

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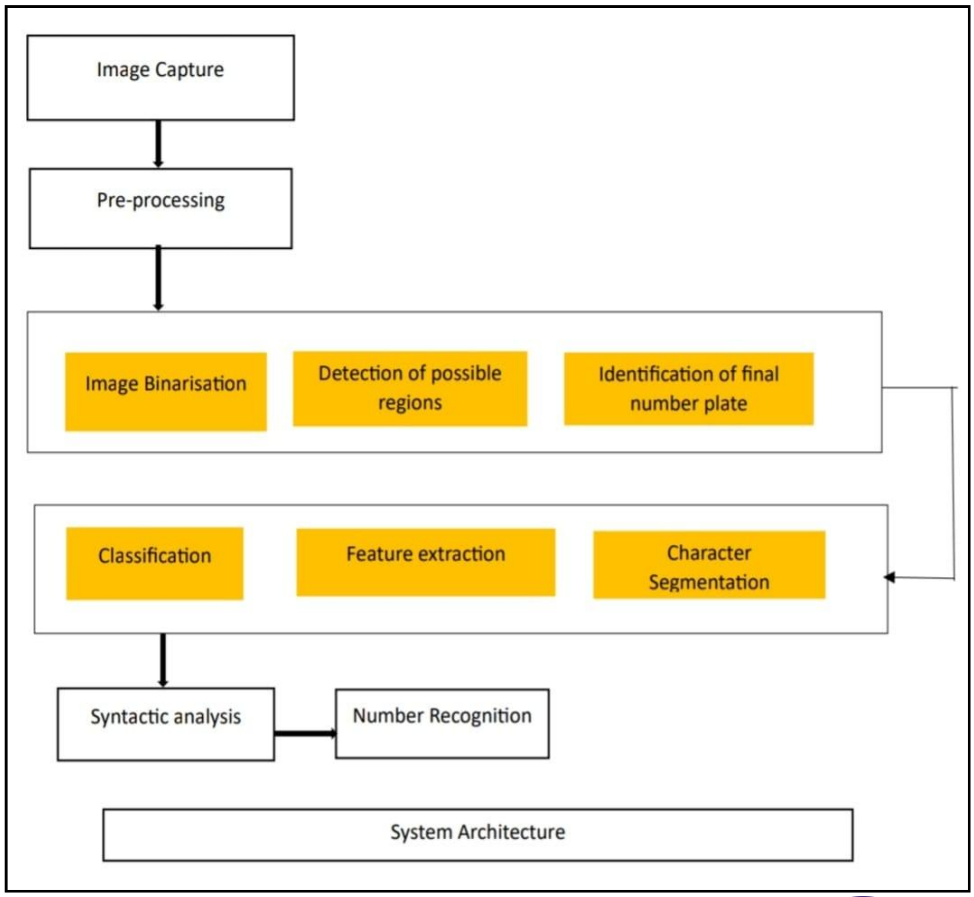
Mr. Kuldeepak et al. In this paper they introduced that high level of precision has been required by the number plate recognition when streets are occupied and number of vehicles are passing through. In this paper, by optimizing different parameters, they have accomplished an exactness of 98. It is essential that for the tracking stolen vehicles and monitoring of vehicles of an exactness of 100 can't be bargained with. Therefore, to accomplish better precision streamlining is required. Additionally, the issues like stains, blurred regions, smudges with various text style and sizes ought to be remembered. This work can be further boundless to minimize the errors because of them.

S. Kaur, K. K. Dhillon, and R. S. Chauhan This paper represents detailed description about vehicle number plate identification system by using Localization, segmentation & recognition of characters.

2.1 Applications

- Parking: The ANPR system is utilized in parking facilities to automate entry for pre-paid members and calculate parking fees for non-members by comparing the exit and entry times. This eliminates the need for manual ticketing or payment processes.
- Access Control: In access-controlled areas, the ANPR system is employed to automatically open gates for authorized members, reducing reliance on security guards. The system records events in a database, enabling event history search and analysis.
- Tolling: ANPR technology is utilized in toll roads to calculate travel fees based on the captured car number. It can also be used to cross-verify ticket information, ensuring accurate billing.
- Border Control: The ANPR system is implemented at national borders to enhance border control measures. Each vehicle is registered in a central database and associated with additional information, such as passport data. This comprehensive tracking system enables monitoring and tracking of all border crossings.

2.2 Proposed System Model



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2.3 Image Preprocessing:

Image pre-processing refers to the set of techniques and operations applied to an image before it is used for further analysis or processing tasks. The goal of image pre-processing is to enhance the quality of the image, extract relevant information, and improve the performance of subsequent algorithms or applications.

- **Image resizing:** This involves changing the size of the image, either by increasing or decreasing its dimensions. It can be useful for standardizing image sizes or reducing computational requirements.
- **Image cropping:** It involves removing unwanted parts of an image to focus on a specific region of interest. Cropping can help eliminate irrelevant background information and improve the efficiency of subsequent algorithms.
- **Image normalization:** This technique adjusts the intensity values of an image to a specific range, often between 0 and 1. Normalization helps to standardize the pixel values and improve the performance of algorithms that are sensitive to intensity variations.
- **Image denoising:** Noise in an image can be caused by various factors such as sensor imperfections, compression artifacts, or environmental conditions. Denoising techniques aim to reduce or remove the noise while preserving important image details.
- **Image enhancement:** This involves applying filters or algorithms to enhance certain image features, such as contrast, brightness, or sharpness. Enhancement techniques aim to improve the visual quality of an image and make it more suitable for subsequent analysis.
- **Image rotation and flipping:** These operations involve rotating an image by a certain angle or flipping it horizontally or vertically. Such transformations can be useful for aligning images or augmenting datasets for training machine learning models.
- **Color space conversion:** Converting an image from one color space to another, such as RGB to grayscale or RGB to HSL (Hue, Saturation, Lightness), can be beneficial for certain tasks like object recognition or color-based analysis.

Fig. RGB to Grayscale

2.4 Image Binarization:

Image binarization, also known as thresholding, is a fundamental image processing technique used to convert a grayscale or color image into a binary image. In a binary image, each pixel is assigned either a black or white value, representing foreground and background, respectively. The goal of binarization is to separate the object of interest from the background by thresholding the pixel intensity values.

- **Grayscale conversion:** If the input image is in color, it is typically converted to grayscale to simplify the binarization process. This can be done using various color space conversion methods, such as RGB to grayscale or HSV to grayscale.
- **Selection of thresholding method:** There are different methods available for selecting the threshold value that separates the foreground and background pixels. Some commonly used thresholding techniques include:

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- **Global thresholding:** A single threshold value is determined and applied uniformly to the entire image.
- **Adaptive thresholding:** Different threshold values are calculated for different regions of the image, taking into account local variations in pixel intensity.
- **Otsu's thresholding:** Otsu's method automatically determines an optimal threshold by maximizing the inter-class variance between foreground and background pixels.
- **Histogram-based thresholding:** Thresholding is based on analyzing the histogram of the image to find significant peaks or valleys that separate the two classes.
- **Application of threshold:** Once the threshold value is determined, each pixel's intensity value is compared to the threshold. If the intensity value is higher than the threshold, the pixel is assigned a white value (foreground); otherwise, it is assigned a black value (background).
- **Post-processing (optional):** After binarization, post-processing operations can be applied to refine the binary image. These operations may include morphological operations like erosion, dilation, opening, or closing to eliminate noise, fill gaps, or smooth the object boundaries.

Fig. Image Binarization

2.5 Plate Localization and Extraction:

Plate localization and extraction, also known as license plate recognition (LPR) or Vehicle Number Plate Identification, is a process in computer vision that involves identifying and isolating license plates from images or video frames. The goal is to accurately locate the license plate in an image and extract it for further processing or analysis.

- **Image acquisition:** The process begins with obtaining an image or video frame that contains a vehicle with a visible license plate. This can be done using cameras, CCTV systems, or other imaging devices.
- **Pre-processing:** The acquired image is pre-processed to enhance its quality and improve the effectiveness of subsequent steps. This may involve operations such as resizing, noise reduction, contrast adjustment, and image normalization.
- **Vehicle detection:** In order to locate license plates, the image is analyzed to identify vehicles or vehicle regions. Object detection algorithms, such as Haar cascades, contour-based methods, or deep learning models, can be used to detect vehicles in the image.
- **Plate region localization:** Once the vehicles are detected, the next step is to identify potential license plate regions within the vehicle boundaries. This can be done using techniques like edge detection, color analysis, morphological operations, or template matching.
- **Plate verification:** To improve accuracy, the potential plate regions are further verified to ensure they are actual license plates and not false positives. This can involve checks for specific plate dimensions, character patterns, or using machine learning algorithms to classify the regions as plates or non-plates.
- **Plate extraction:** After the license plate regions are verified, they are extracted from the original image by cropping the corresponding region of interest (ROI). The extracted plate becomes an individual image that can be used for subsequent processing, such as character recognition or vehicle identification.

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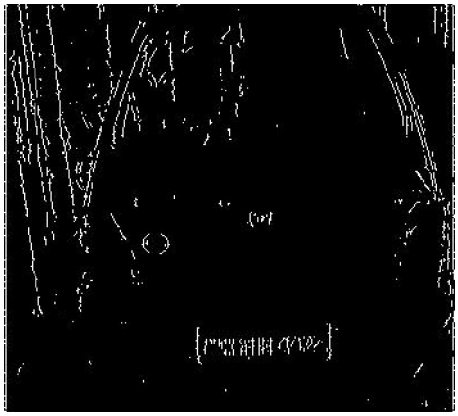

Fig. Localization

2.6 Character Segmentation:

Character segmentation, also known as license plate character extraction, is a critical step in license plate recognition (LPR) systems. After localizing and extracting the license plate region from an image, character segmentation involves dividing the plate into individual characters, separating them from one another to enable subsequent character recognition or optical character recognition (OCR) algorithms to accurately identify and interpret each character.

- **Pre-processing:** The license plate image is pre-processed to enhance its quality and improve the effectiveness of character segmentation. This may involve operations like resizing, noise reduction, contrast adjustment, and image normalization, similar to the pre-processing steps mentioned earlier.
- **Thresholding:** A common technique used in character segmentation is thresholding, where an image is converted to a binary format, separating the foreground (characters) from the background. This helps in distinguishing characters from the surrounding areas.
- **Connected component analysis:** Once the image is binarized, connected component analysis is performed to identify individual character regions. Connected components are groups of adjacent pixels with the same intensity value. By analyzing these connected components, potential character regions are identified.
- **Filtering and validation:** Not all connected components detected in the previous step may correspond to actual characters. Filtering techniques are employed to eliminate noise and false positives. This can involve considering the size, aspect ratio, and shape of the connected components, as well as using pattern recognition or machine learning algorithms to validate and classify regions as characters or non-characters.
- **Character separation:** The remaining connected components are considered as potential characters. In this step, techniques such as contour analysis, edge detection, or horizontal projection profiles are used to separate characters from each other. The goal is to find gaps or spaces between characters and divide the license plate image into individual character images.
- **Character normalization:** After segmenting the characters, further pre-processing steps may be applied to normalize them. This can involve resizing the characters to a standard size, normalizing their orientation, or adjusting their contrast and brightness to enhance recognition accuracy.
- **Character recognition:** Once the characters are successfully segmented and normalized, they are passed on to character recognition algorithms or OCR systems for further processing. These algorithms analyze the individual character images and interpret them as alphanumeric characters, enabling license plate information extraction.

Fig. Image Segmentation

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2.7 Character Recognition:

Character recognition is a crucial step in the Vehicle Number Plate Identification process. It involves utilizing the Tesseract OCR engine to identify and interpret the alphanumeric characters present on the detected license plate. The Tesseract engine used in this process has undergone training to enhance the accuracy of character recognition. This training involved creating character images with expected fonts and compiling a dictionary of possible character combinations found on license plates, including regional codes, suffixes, and registration numbers.

The outcome of the character recognition stage is the extraction of text representing the vehicle number from the license plate.

Fig. Character Recognition

Output:

Fig. Output

The output provides the recognized number plate from the vehicle image, followed by the relevant owner's information associated with that number plate. The owner's information can include details such as the owner's name, vehicle type, Registration date, Model, RC Status, City and State of owner.

III. CONCLUSION

This paper introduces Vehicle Number Plate Identification system that focuses on recognizing vehicle license plates. The system leverages image processing techniques to match the captured vehicle image with the database stored in a

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computer, as specified by the user. It demonstrates good performance under various conditions and different types of number plates. The implementation is carried out in Python, and its effectiveness is tested on real-world images.

The existing work has primarily addressed the challenge of recognizing distorted number plates. However, it encounters issues related to noise and image quality when captured from a distance. In this proposed work, a novel system is presented, which includes a denoising approach to improve the image quality and employs standard classifiers of neural networks for enhanced character recognition. Furthermore, the system incorporates body detection to provide more accurate results.

The proposed system operates in conjunction with a cloud database for an entry and exit registry system. It locates and stores the vehicle owner's details, aiming to identify the owner of a particular vehicle by detecting its license plate. The primary objective is to detect vehicles, capture their number plates, and retrieve the relevant owner information.

IV. FUTURE SCOPE

The future scope of vehicle number plate detection using computer vision is promising and encompasses various domains such as traffic management, parking, surveillance, access control, and automation. It can aid in enforcing traffic laws, managing parking reservations, streamlining toll collection, enhancing vehicle surveillance, facilitating automated access control, supporting smart city initiatives, enabling autonomous vehicles, and improving insurance and anti-fraud measures. Continued advancements in computer vision algorithms and hardware capabilities will further enhance the accuracy, speed, and reliability of these systems, leading to innovative applications and improved road safety.

REFERENCES

[1]. Du, S., Ibrahim, M., Shehata, M., and Badawy, W. (2013). "Automatic License Plate Recognition (ALPR): A State-of-the-Art Review." IEEE Transactions on Circuits and Systems for Video Technology.

[2]. Sulaiman, N., Jalani, S. N. H. M., Mustafa, M., and Hawari, K. (2013). "Development of automatic vehicle plate detection system." 2013 IEEE 3rd International Conference on System Engineering and Technology.

[3]. S. Kaur, K. K. Dhillon, and R. S. Chauhan, An Automatic System for Detecting the Vehicle Registration Plate from Video in Foggy and Rainy Environments using Restoration Technique, International Journal of Computer Applications, vol. 97, no. 20, pp. 14-19, Jul. 2014.

[4]. Islam, R., Sharif, K. F., and Biswas, S. (2015). "Automatic vehicle number plate recognition using structured elements". 2015 IEEE Conference on Systems, Process.

[5]. Sarthak Babbar, Saommya Kesarwani, Navroz Dewan, Kartik Shangle and Sanjeev Pate l" A New Approach for Vehicle Number Plate Detection". 11th International Conference on Contemporary Computing (IC3), IEEE 2018

[6]. C. Henry, S. Y. Ahn and S. -W. Lee, "Multinational License Plate Recognition Using Generalized Character Sequence Detection," in IEEE Access, vol. 8, pp. 35185-35199, 2020, doi: 10.1109/ACCESS.2020.2974973.

[7]. F. A. Aiyelabegan, C. C. Emmanuel, S. Thomas, F. A. Imam, H. Haruna Ginsau and F. Onah, "Proposed Automatic Number Plate Recognition System Using Machine Learning," 2022 IEEE Nigeria 4th International Conference on Disruptive Technologies for Sustainable Development (NIGERCON), 2022, pp. 1-5, doi: 10.1109/NIGERCON54645.2022.9803181

[8]. Priyanka Prabhakar, P Anupama, S R Resmi, "Automatic vehicle number plate detection and recognition(IEEE 2020)" Md. Atikuzzaman, MdAsaduzzaman, Md. Zahidul Islam, "Vehicle Number Plate Detection and Categorization Using CNNs(IEEE 2020)"